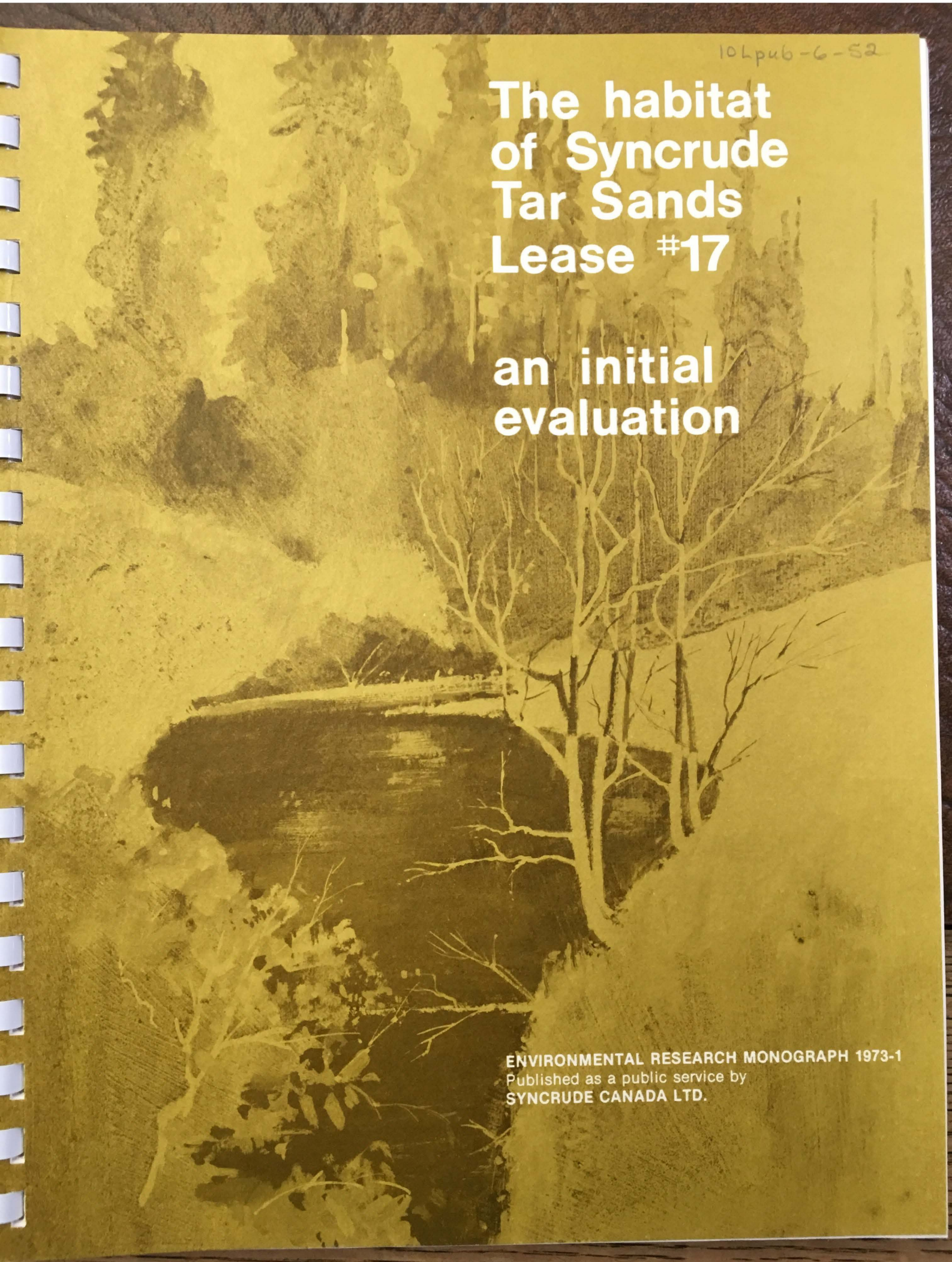
The habitat of Syncrude Tar Sands Lease #17

an initial evaluation



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FOREWORD

Syncrude Canada Ltd. has been involved in environmental studies since the beginning of its development activities in the Athabasca Tar Sands. Many of the early studies had direct engineering implications. More recently, Syncrude has commissioned studies to determine effects and mitigation possibilities concerned with possible alteration of biological resources.

Syncrude Canada Ltd. recognized the need for an understanding of the ecosystem in which the development is taking place. Renewable Resources Consulting Services Limited, ecological consultants of Edmonton, Alberta, were retained to carry out the studies presented in this publication.

The Management of Syncrude Canada Ltd. feel that scientific information which results from these studies should be placed in the public domain. We feel a responsibility to contribute to the body of knowledge necessary for orderly development of the Tar Sands, in order to minimize damage and maintain ecological integrity.

Other studies, many of a preliminary or first-survey nature, have also been carried out. It is the intention of Syncrude Canada Ltd. to release other information in subsequent environmental monographs. These publications will be available upon completion of the studies. We sincerely hope that this information will be helpful to the scientific community and to the citizens of Alberta who are concerned with the management of resources on a sound ecological basis.

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Appreciation is expressed to Canadian Utilities Limited for permission to reprint, from ALBERTA: A Natural History, excerpts from the definitive work by Drs. George H. La Roi and Cyril G. Hampson.

The Editor
Syncrude Canada Ltd.

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ABSTRACT

Syncrude Canada Ltd. Lease 17 is located in the boreal mixedwood forest ecosystem. It lies within an area of moderately-low biological productivity. Thirty per cent of the lease is in the muskeg habitat type. The winter climate is severe. Energy cycling between soils, plants and animals occurs at comparatively slow rates. There are relatively few steps between food-producing organisms and food-consuming organisms, in comparison with temperate zone ecosystems.

Twelve terrestrial and aquatic habitat types exist on the lease. These plant communities offer a variety of cover to wildlife. Terrestrial habitats of mature forest cover are restricted to eastern and southern portions of the lease. Much of the lease has been burned by forest fires prior to our development. The most important winter habitat of moose, based on productivity per unit of area, was riverine association.

Other important winter habitats for moose were boreal mixedwood (spruce-aspen) association and pure aspen consocies. Treed muskeg and older burn (aspen) were of secondary importance. The boreal mixedwood (spruce-aspen) association comprised the most extensive moose winter habitat.

Potential habitat exists on the lease area for deer and caribou, but deer may be limited by snow conditions and competition with moose for saskatoon-berry in pure aspen stands. Some habitat types were suitable for black bear, ruffed grouse, spruce grouse, ptarmigan, and other species. Rabbits utilized all habitat types, causing severe browsing in some areas. Wolves, coyotes and lynx were common to all habitat types.

Areas of key moose wintering habitat determined in this study, and moose distribution on Lease 17 as determined by the big game survey of February 1972, were closely correlated.

Locations of moose in February 1972 were checked on the aerial photos and habitat map (Figure 1). Five moose were distributed on the southwest corner of the lease near the MacKay river, and eight were distributed on the eastern quarter of the lease. Of the five moose near the MacKay River, all were located on aspen-dominated old burns (Type 9) near to willow or open muskegs. Of the eight moose on the eastern portion, three were located in pure aspen (Type 1), three in the spruce-aspen (Type 4A), one in Type 1 or treed muskeg (Type 6), and one in riverine (Type 10). This corresponded fairly well with assessments of these habitat types for wintering moose.

Only one moose was noted in the riverine habitat although this area appeared to be most heavily utilized. Moose were missed in this type in the survey either because of heavy timber cover or because they moved down along the river after February.

No moose were located in the spruce-aspen type that covers a good portion of the south part of the lease.

Aquatic habitats are limited on Syncrude Lease 17. The Beaver Creek drainage is good beaver habitat. Mildred and Horseshoe Lakes offer habitat to waterfowl, especially as feeding areas during migration; summer waterfowl nesting habitat is limited.

CHAPTER ONE

PHYSIOGRAPHY AND DRAINAGE BASINS

CLIMATE

SOILS

Introduction:

The bituminous sands mineral surface leases held by Syncrude Canada Ltd. are all located in the boreal mixedwood forest. Good land management on these leases requires an understanding of the ecosystem or ecological region in which these leases are located, and an evaluation of habitats.

The boreal mixedwood forest in Alberta occupies the northeastern portion of the province. It extends west from the Saskatchewan border to about the Pease River, and from the boreal sub-Arctic lowlands on the north to the aspen parkland ecotone on the south. It encompasses large areas of bog and muskegs, and covers about 80,000 square miles

Physiography and Drainage Basins

This ecological region begins on the eastern Alberta plains on the south. Proceeding northward, it includes the Lesser Slave Lowlands, the Stony Mountain, and Mostoos Hills Uplands. Continuing north (in the bog-muskeg zone) it includes the Methy Portage Plain, the Algar Plain, the Loon River Lowlands and the Clearwater Lowlands (the location of Lease 17). Prominent heights of land further north include the Buffalo Hills Upland, the Birch Mountain Upland, and the Muskeg Mountain Upland. Surficial

deposits on the lowlands are, primarily, outwash, lake deposits, and wind deposits of sand and gravel. Along the Athabasca River the soils change to lacustrine silts and clays, while the uplands of the Birch Mountains are, primarily, ground moraine and hummocky moraine till parent material.

The underlying Cretaceous shales had been glaciated; this has produced a rolling morainal topography. The soil mantle is rich in clay, characteristic of Gray-Wooded soils which have developed on upland terrain. These soils are favourable to the growth of the mixedwood forest community.

The main drainages within this region are the watersheds of the Athabasca, Wabasca, Birch and Peace Rivers.

Bedrock geology studies of this region indicate that most of it lies in the Upper Cretaceous zone. Bedrock is primary shales and minor sandstone of the La Biche group. The Pelican Mountains, and other outliers, are of Upper Cretaceous origin--primarily sandstones, shale and coal of the Wapiti Formation. Of special note is the bedrock geology around Fort McMurray. This is in the Lower Cretaceous zone, and contains shales and sandstones--including the oil sands of the McMurray Formation and the Joli Fou Formation. Adjacent to Ft. McMurray is also an area of Lower Cretaceous sandstones of the Pelican and Grand Rapids Formations. A portion of the river valley in the Athabasca and Clearwater River junction is of Devonian origin, including limestone, shale, dolomite and minor gypsum.

The mixedwood forest region is an area of rolling topography of uplands and heights of land with many low-lying areas. The low-lying areas generally fall into the bog-muskeg or sedge fen classification. The major riverbreak zones in this region are the Athabasca, Wabasca, Birch and

Peace Rivers. The mixedwood forest region is difficult to delineate, as the ecotone (or transition) between aspen parkland and mixedwood forest, along the southern boundary, is extremely irregular. The Birch Mountains in the northeast are known specifically to be an area where permafrost occurs in organic soils.

Climate

The climate in this region is generally dry subhumid, in the lowlands, and moist subhumid in the uplands. Precipitation is higher in the uplands, and noticeably lower in the lowlands along the Athabasca River Valley. Precipitation in the region ranges from 16 - 22 inches. Growing season precipitation (April through August) is approximately 8 - 10 inches. Mean annual snowfall is 60 - 80 inches. Snowfall exceeds 80 inches in the Buffalo Head Hills, the Birch Mountains, and the Highlands southeast of Fort McMurray. The variability of precipitation during the growing season is approximately twenty-five to thirty per cent. This is relatively stable, compared with the rest of the province. The average number of days during which precipitation occurs is approximately 130 days. This is the highest category of precipitation frequency in the province. This region is characterized by comparatively-low average potential evapotranspiration. The actual average evapotranspiration is relatively high, compared to the rest of the province. (Potential evapotranspiration is the measure of heat supply available to evaporate and transpire moisture where soil moisture supplies are not limited. Actual evapotranspiration is a measurement of average soil moisture storage--with capacities of four inches at present. It is a measure of the actual growth potential.) Areas of low values are either cool or dry. The average deficiency, based on areas

with limited soil moisture recharge characteristics of the uplands and higher elevations of the region, is 2 - 4 inches (12-inch storage); average moisture deficiency does not exceed 4 inches (4-inch storage).

A climatic summary of the region:

1. Average annual precipitation--14 - 20 inches, increasing with elevation;

2. Growing season precipitation (April through August);

3. Average 9 inches of rain;

4. Average annual snowfall: 60 - 80 inches locally, higher on the uplands;

5. Hours of sunshine for the region--1900, increasing westerly;

6. Percentage of sky covered in March--approximately seventy-five per cent during the daylight hours;

7. Percentage of sky covered in August--sixty to sixty-five per cent;

8. Last spring frost--average between June 1 and 15;

9. Frost-free period: approximately 90 days. Some variability occurs in this date on the uplands in the north of the region. Here, frost may occur in any month of the year;

10. Less than ten winter days when the maximum winter temperature exceeds $40^{o}F$;

11. Less than twenty days in the summer where maximum temperature exceeds $80^{o}F$;

12. Westerly winds prevail throughout the region. A lack of reporting stations in this region makes it difficult to give more specific data on wind direction and velocity. It can be generally stated

that summer winds are southwesterly 4 - 12 miles per hour, while in the fall and winter the direction switches to northwest--increasing at times to an average of 12 - 20 miles per hour. Wind measurements from Fort Smith at the northeast corner of the province indicate almost uniform variability in direction, and velocities of 4 - 12 miles per hour at most seasons of the year;

13. Temperature inversions can be expected in the major river valleys in the absence of air movement (winds), especially during the mid-winter months.

Soils

This region is situated primarily in the Grey Wooded soil zone of Alberta. However, the region contains large acreages of organic Brown Wooded and acid Brown Wooded, Dark Grey and Dark Grey Wooded soils, and gleisolic soils.

The Dark Grey and Dark Grey Wooded soils are generally located along the ecotone with the parkland region adjacent to the North Saskatchewan River. Solonetzic soils generally do not occur in this region, except in isolated localities.

Organic soils are those which have over 12 inches of peat at the surface. Although some organic soils have more than 10 feet of peat, the average is about three to four feet. Peat is mainly derived from sphagnum moss, although some is derived from sedge vegetation. Peat is acid to moderately-acid in reaction, and has a high water-holding capacity. Very limited acreages of these soils have been cultivated within this region, as they are susceptible to frost. Organic soils on the uplands throughout the region generally have a climafrost or permafrost layer approximately 24 inches

below the surface. Most of the organic soils occur in the bog-muskeg land form.

Dark Grey Wooded soils and Grey Wooded soils occur in areas of dry subhumid to subhumid climate where there is fairly continuous tree cover. Also included in this group are the Bisequa Grey Wooded soils. Grey Wooded soils usually have a thin leaf mat on the surface. Under the leaf mat is a black to dark grey surface horizon, three to ten inches thick. Below this, there is often a deep, very light grey horizon. The lime concentration is generally 40 - 60 inches below the surface. Productivity of these soils for agricultural crops is moderate, but is seriously restricted by other climatic factors within this region.

Orthic Grey Wooded soils and their variants within this region follow the characteristic growth potentials as Grey Wooded soils in other portions of the province. The exceptions to the normal pattern are the constraints caused by climate, and lack of available soil moisture during the growing season.

Because of soil characteristics alone, much of the region must be classified as the bog-muskeg land form.

Approximately thirty per cent of Lease 17 lies within the bog-muskeg zone. These areas have numerous environmental constraints. The soils in these areas are, basically: organic and gleisolic soils formed on glacial till, gravelly outwash, alluvial and lacustrine parent material. The extent of well-drained soils is somewhat limited; the lease area is generally characterized by a significant percentage of sphagnum moss bogs (muskegs).

Peat bogs have a regulating effect in maintaining water levels in streams and local water tables, and in preventing erosion of soil when large volumes of water are suddenly spilled into the stream channel.

CHAPTER TWO

THE BOREAL MIXEDWOOD FOREST

General Vegetation:

The Boreal Mixedwood Forest is a mosaic of deciduous poplar and evergreen white spruce stands, interspersed with willow, black spruce and associated muskegs. The understory vegetation in the timber stands contains a diversity of plants and animals, especially in poplar stands. White spruce replaces poplar in older forests, where seed sources are available. Frequent forest fires encourage poplar growth, as poplar reproduction sprouts from surviving root suckers, whereas spruce regenerates from seed. Large and black spruce trees are associated with the vast expanses of muskeg on the poorly-drained lowlands. Muskeg, a generic term, is composed of water-logged moss-peat (sphagnum) or fens (sedges), according to the amount of calcium in the substrate. Jackpine stands occur on well-drained sandy ridges.

La Roi (1967) has divided the boreal mixedwood into two categories: (a) the aspen-dominated mixedwood forest, and (b) the spruce-dominated mixedwood forest. By understanding the environmental controls of each of these sub-types, we can synthesize the inter-relationship between the two communities. The controls are light, soil moisture, solar energy, the timing or photoperiodicity which changes seasonally, and the chemical and physical characteristics of the soil substrate. Deciduous trees have different growth characteristics than evergreen trees. In turn, different overstory trees create conditions on the ground which favour the growth of different shrubs and herbs.

The Aspen-Dominated Mixedwood Forest:

In the trembling aspen stand the living trees are 60 years old and about 80 feet tall. They have smooth, gray-green trunks which retain no branches near the ground and are capped by shallow, convex crowns intermingling to form a stippled summer-green canopy, in which the leaves flutter on the slightest breeze. This canopy intercepts only a moderate amount of sunlight and rainfall, allowing the remainder to fall upon the stand interior. When the leaves drop in autumn, the forest becomes much more open to sun, wind, rain and snow.

Here and there amid the living trees, either fallen or still standing, are dead aspens of assorted smaller sizes in various stages of decomposition. These trees have been eliminated through the quiet but vigorous competition within the aspen population for light, water and nutrients. This struggle began with the establishment of the stand and will continue to its end. Whether this tree or that one survives depends largely on their relative growth rates and the maintenance of a sunny exposure. These two factors, in turn, are strongly influenced by reductions in the photosynthetic output of the leafy crowns, that is, in the use by leaves of sunlight combined with plant nutrients for the manufacture of food. These reductions in photosynthesis can come from insect predation or through damage by wind and ice. Another controlling factor is the relative amount of water and nutrients readily available to the root systems of the competing trees.

Moving into the warm, sun-flecked stand interior, we find that it is difficult to see the ground surface through the profusion of shrubby and herbaceous vegetation. This lush undergrowth consists of numerous shrubs reaching to the waist, even more shrubs and tall herbs reaching the calf, and under these, dense patches of dwarf shrubs and low herbs at ankle height. Pushing aside this leafy growth, we see that the forest floor is matted with moist, rapidly-decaying and nutrient-rich aspen leaves together with a sprinkling of twigs and other detritus and a host of ants, worms and other invetebrate animals. True mineral soil lies about three inches below the litter surface and is crowded with roots. Fallen longs and tree bases rise above this leafy litter, harbouring mixtures of shade-tolerant mosses.

Among the more abundant medium shrubs are the moose-berry, saskatoon, red osier dogwood, red raspberry and, in drier areas, hazel and buffalo-berry. The lower shrubs commonly include prickly rose, red and other currants,

bracted honeysuckle and snowberry. With or just below these are large numbers of wild sarsaparilla, hairy lungwort, asters, wild pea, vetch, blue-joint, and in drier openings, pine grass. Of the many dwarf shrub and low herb species the following are most numerous: twin-flower, strawberry, bunchberry, bishop's cap, horsetails, dwarf raspberry and several wintergreens. There are signs of change in this aspen stand. Hidden amongst the shrubs and herbs one finds occasional seedlings and young trees of white spruce; but only rarely do we find young trembling aspen, though the canopy above sends down millions of seeds each year.

It is of historic and geographic interest that half of the plant species and all but one genus listed above occur in similar forests of the Eurasian boreal taiga.[1]

The Spruce-Dominated Mixedwood Forest:

Dr. La Roi continues:

The living trees in the white spruce stand are mostly about 70 years old and 80 feet tall, but the range in age and size is somewhat greater than in the aspen forest. The spruce trunks have think, ashy-brown scaly bark, retain small dead branches near the ground, and are topped by deep, pyramidal evergreen crowns. These crowns do not intermingle to the same extent as those of aspen, but they are far denser and therefore much more effective absorbers of light. Their needles also catch and return to the atmosphere much of the water in light summer showers, thus strongly reducing precipitation as well as light intensity in the forest interior throughout the year. Evidence of competitive thinning in the maturing spruce forest is similar to that for aspen, except that overtopped and suppressed trees seem to "hang on" longer before capitulating.

As we move into the summer spruce forest, we quickly notice the remarkable change in climate from that outside. The interior is far cooler and the light more subdued than in the aspen forest. The air is humid and still, thick with the scent of sun-warmed spruce needles from above and the distinctive essence of mosses from beneath our feet. Instead of wading through a mass of woody and herbaceous plants, we walk upon soft carpets of "feather" mosses, interrupted only occasionally by localized patches of dwarf shrubs and low herbs, by accumulations of spruce needles around the bases of trees, or by piles of spruce cone scales harvested by

red squirrels. Medium and low shrubs are far less numerous here than in the aspen stand; those few present are straggly and bear little or no fruit.

Three feather mosses dominate the forest floor: *Hylocomium splendens, Pleurozium schreberi* and *Ptilium crista-castrensis*. These same three species produce similar carpets throughout the taiga of both North America and Eurasia. The living green part of the moss carpet in our spruce stand is about three inches thick, and is permeated with spruce needles. Below this level the moss parts are clearly discernible though colorless for an inch or so, but then begin to disintegrate along with the spruce needles into a moist, cottony fermentation layer of white or yellow fungal threads. The next two inches consist of a blackish-brown, acidic peat like material, with a network of roots lying on the gray surface of the mineral soil.

Among the more persistent and successful shrubs rooted in or through the moss carpet are green alder, mooseberry and prickly rose. The most extensive colonies of dwarf shrubs and low herbs are dominated by bunchberry, twin-flower, horsetails, wintergreens, wild lily-of-the-valley, cowberry and northern comandra.

A careful search of the forest floor eventually finds a few very slow-growing white spruce "seedlings", some rooted in the cracks of rotting logs, others growing in places where the mineral soil has been exposed by disturbance of the moss carpet.[2]

* * * * *

. . . (Environmental conditions in the mixedwood forest) should make it clear that trembling aspen and white spruce trees are as different in their influence on their surroundings as they are in appearance. . . .

The contrasting effects of deciduous broad leaves and evergreen needle leaves are of crucial significance. The amount of solar energy reaching the aspen stand interior is greater at all seasons, and much greater after leaf fall than that percolating through the relatively unchanging spruce canopy. As a result, photosynthetic production and consumer food supply can be far higher among the shrubs and herbs under the aspen trees than is possible for the feather mosses under the spruce canopy. In the spring, direct heating of the aspen forest floor by

by the sun quickly melts the snow-pack and warms the soil. In the white spruce stand, the melting and warming process takes longer, since it is caused only by the diffuse light from the sky and the indirect conduction of heat by air and rain. Hence many shrubs and herbs are leafing out and flowering before the aspen canopy forms and before the last trace of snow finally disappears from the shaded moss carpet of the spruce forest.

. . .

Old spruce needles are tough in texture and strongly acid in composition. Very few species of vertebrate or invertebrate animals will eat them. Combined with dead moss parts at the bottom of the cool moss carpet, they do form a suitable energy source for those fungi, termed saprotrophic, which feed on dead organic materials. Even the fungi, however, cannot completely utilize the needle-moss mixture, and the partially decomposed peat-like remains gradually pile up as the spruce forest grows older. As water percolates down through the moss carpet and peaty layer, it picks up free organic acids and carries them into the mineral soil. Here the acids tend to displace and leach away essential nutrient compounds. Meanwhile other nutrients are imprisoned in the substance of the peaty material and are for the most part unavailable for use by green plants. The product of interaction between spruce needles, mosses, fungi, low temperature and water percolation is an acid-rich and nutrient-poor rooting medium, which approaches or exceeds the limits of tolerance of many plant and animal species that thrive in the aspen forest.

In contrast, dead aspen leaves are quite palatable and are therefore readily eaten by many invertebrate animals. By the middle of summer, most of the previous year's leaf fall has been consumed by thousands of detritus-feeders, and the egested wastes passed on to a host of secondary consumers, from earthworms to bacteria. In this way the energy bound up in the litter of the aspen stand is largely captured by consumer and decomposer organisms, and then released as respiratory heat. As a result, the mass of organic matter in the litter declines rapidly as free carbon dioxide is respired to the air. The remaining humus materials are thoroughly mixed with the mineral soil by burrowing animals. The thorough decomposition of the aspen leaves permits a fast and efficient release of nutrient compounds which are quickly absorbed and re-cycled into use by the roots of all green plants in the stand. Thus the interaction between aspen leaves,

detritus feeders, decomposer organisms and warm, moist conditions ensures the production and maintenance of a non-acidic and fertile rooting medium for many boreal plants and the organisms which live among, or feed upon them.

. . .

Thus in our "typical" mixedwood upland stand we find small clumps of pure aspen and spruce scattered in a larger area of varying combinations of the two. The subordinate vegetation layers in the centre of the pure clumps closely resemble those of the two stands already described. Layers under mixed canopies are in many respects predictably intermediate or transitional in appearance, but in other ways quite different. For example, certain plant and animal species with only feeble representation in both spruce and aspen stands--such as the ruffed grouse--are much more common in areas where the two trees are intermingled. Other species are present here but missing entirely from spruce and aspen. These facts seem curious.

Part of the explanation appears to lie in what has aptly been called "hybridization of the habitat". There are two aspects to such hybridization--quantitative and qualitative. The former is easily understood, for it simply refers to the production of environmental conditions, light, for example, of which the intensities are between those of either pure aspen or pure spruce. Species better adapted to such intermediate habitats will prosper in them, often at the expense of competing species.

The qualitative aspect refers to the synthesis of different kinds of habitat conditions or components from precursors in the pure spruce and pure aspen stands. A simplified example will illustrate this. Some of the organic products of decomposition in a mixture of decaying aspen leaves and spruce needles do not occur in either unmixed rotting aspen leaves or unmixed old spruce needles. These "new" organic compounds form necessary links in a food chain of decomposer micro-organisms which now proceed to convert the litter into a distinctive kind of humus found only under mixedwood canopies. This "new" humus, in turn, is a favorable rooting medium for several flowering plants which do not occur in either the aspen or the spruce stands. The humus also tilts the competitive balance in favor of certain species which were of only minor importance in the pure stands.[3]

Forest succession follows a sequence. Dr. La Roi states:

> If there are no fires and seed is available from surrounding vegetation, we shall first of all find a slowly-increasing number of shade-tolerant young white spruce trees becoming established in the lower layers of the aspen stand. Because of intense competition for light, water and nutrients with the surrounding herbs, shrubs and trees, the growth rate of the invading spruce population is at first very slow, and many seedlings perish during dry spells or are smothered under a blanket of aspen leaves. As time goes by, however, the young spruce trees begin to overtop and suppress their competition, and begin to alter their surroundings in the manner described earlier.
>
> Meanwhile, the rate of increase in size of the short-lived aspen trees slackens perceptibly. Injuries arising from grazing animals, various insects and the weather continue to provide access to wood-rotting fungi, which subsequently prepare the trees for wind breakage. In this way, the number of healthy aspen declines, and gaps appear in the tree canopy. . . .
>
> The replacement of one distinctive phase of the mixedwood community by another is a long process. The lingering old aspen trees continue to exert great influence on the physical, chemical and biological properties of the developing spruce stand. Even after the last veteran aspen has fallen, many years pass before the soil, flora and fauna of the aspen forest are completely succeeded by those of spruce. It seems, indeed, that the best growth of the spruce forest is made before the relatively high potential production of the aspen habitat has been depleted.[4]

The preceding discussion of ecological succession makes the assumption that the forest has been protected from fire. However, the effect of fire must be taken into consideration as it affects the retardation of ecological succession.

CHAPTER THREE

WILDLIFE

Animals:

The animal component of the mixedwood forest is highly diverse. "In spring and summer thousands of birds wing their way to (the depths of the mixedwood forest) to breed and nest..... Waterfowl of many species nest along or near the shores of the multitudinous ponds, sloughs and lakes or in marshy areas..... Some birds, like the chickadee, are year-round residents."[5] Most representative of bird life in the boreal mixedwood forest are the ruffed and spruce grouse, the Richardson's owl and the goshawk.

The dominant ungulate is the moose, with mule deer, white-tailed deer and elk indigenous to certain portions of the region. Woodland caribou are found in the northern portions, and aggregate in small pockets. The mixedwood forest is a favorite habitat of the American black bear. Major carnivores are the wolf, coyote, lynx and wolverine. Lesser carnivores are the fisher, weasel, and otter. Lagomorghs are represented by the MacKenzie's varying hare; the rodents, by the Northern red-backed vole. Many of these smaller animals act as "buffer species" between the larger ungulates and major carnivores.

Snow depths are a limiting factor in the distribution of smaller ungulates (deer). A depth of twenty-four inches or more significantly impedes travel by deer, although of less importance to elk and moose. The characteristics of the snow crusting and layering are even more important year by

year than snow depth alone. A massive die-off of elk and moose seems to have occurred in two late-nineteenth century winters, due to the effect of severe cold and fluctuating temperatures. This caused crusted snow, which resulted in mechanical injury to lower limbs, and a viral or bacterial epizootic which caused infections and death. This has altered ungulate numbers and distribution, in this region, to the present time.

Settlement patterns around the fringes of this region have in some ways caused a change in animal distribution. Mule deer do not adapt well to areas of intensified cultivation, while white-tailed deer adapt well, as long as sufficient heavy-cover patches remain. Moose in North America do not adapt well in settlement areas, unlike the Scandinavian moose. As settlement encroaches, moose simply move to more solitary habitats in the adjacent heavy cover of river valleys in the mixedwood forest. Ecological relationships of animal population in winter are well described by Dr. William A. Fuller.[6]

Wildlife Common to Most Habitat Types on Lease 17:

Wildlife species which ranged over most of the habitat types included the major predators.

Timber wolves (*Canis lupus*) appeared to be common over the lease area and tracks were observed near Horseshoe Lake and west of the test pit area. A trapper in that area reported that three or four wolves frequented the area over the winter months, while larger packs were noted to pass through.

Coyotes *(Canis latrans)* appeared common over the lease area, and at least six were observed during the course of the study.

Canada lynx *(Lynx canadensis)* appeared common. Four were observed during the course of the study. A local trapper caught fifty-two lynx on the lease area last winter, and it would appear that they have reached peak populations--following an apparent recent peak of rabbits.

Rabbits were the most abundant of all mammals, and utilized almost all habitat types available. Regular rabbit runs criss-crossing muskegs were noticeable from aircraft. Judging by the abundance of remains seen in the woods and by the heavily-browsed condition of shrubs in recent years, it would appear that a rabbit population "crash" occurred last winter (1970 - 1971) and/or the winter before, although rabbits were commonly seen during the field work. Lynx populations usually "crash" about one year after rabbits do.

Trend Index Data--Pellet Plots:

Pellet plots were set up on eastern portions of the lease to compare present utilization of two habitat types on the lease, and to measure trends of moose populations over the years.

The plots are as outlined on Table I. As mentioned previously, pellet plots gave a good comparison of use of two of the key browse wintering habitats: pure aspen and riverine habitat. Comparison corresponded closely to browse measurements. More plots should be set up when time permits as some of the present plots will be eradicated by development.

TABLE I

Plot	Location	Type	Number of Pellet Groups
1	N.E. corner--Mildred Lake	Pure Aspen	4
2	Same	Same	2
3	Same	Same	1
4	Same	Same	3
5	Same	Same	0
6	Flats east of Horseshoe L.	Riverine	7
7	Same	Same	1
8	Same	Same	4
9	Same	Same	2
10	Same	Same	2
11	Syncrude Air Strip	Pure Aspen	1
12	Same	Same	0
13	West side of Beaver Creek	Same	1
14	Same	Same	2
15	Same	Same	4
		TOTAL	34

Average per 1/50 plot = 2.3

TABLE II

Birds observed on the lease area during Spring 1972 (except waterfowl) included:

Snow buntings *(Plectrophenax nivalis)* - Large flocks of migrants

Horned larks *(Eremophila alpestris)* - Large flocks of migrants

Marsh hawk *(Circus cyaneus)* - Resident on lease

Osprey *(Pandion naligetus)* - One at Horseshoe Lake in early May

Robin *(Turdus migratorius)* - Common

Thrush, Gray-cheeked *(Hylocichla minima)*

Thrush, Swainson's *(Hylocichla ustulata)*

Thrush, Hermit *(Hylocichla ustulata)*

Red-winged blackbird *(Agelaius phoeniceus)* - Nests around lakes and marshes on lease

Sparrow, white-throated *(Zonotrichia albicollis)*

Common nighthawk *(Chordeiles minor)* - Appear to nest in treed muskeg

Eastern Kingbirds *(Tyrannus tyrannus)* - Late arrivals

Ruffed grouse *(Bonasa umbellus)*

Spruce grouse *(Canachites canadensis)*

Great-horned owl *(Bubo virginianus)* - Resident in aspen grove at N.W. corner of Mildred Lake

Downy woodpecker *(Dendrocopos pubescens)*

Solitary sandpipers *(Tringa solitaria)* - Resident along the Beaver River

Black-bellied plovers *(Squatarola squatarola)* - migrants

Lesser-yellowlegs *(Totanus flavipes)* - Common residents

CHAPTER FOUR

THE ROLE OF FIRE

Dr. George H. La Roi describes the role of forest fires as an ecological factor in the boreal mixedwood forest:

> . . . the records for 1957 show that more than 20 per cent of the entire boreal forest area, including lowlands, was burned over at least once in the short interval of 15 years. Since white settlement, the frequency of forest fires has risen. Yet there is convincing evidence from burn scars on old trees and charcoal in the soil that lightning, Indians and other agents caused vast conflagrations long before the arrival of the first white explorers, fur trappers and traders.
>
> Fires are usually more frequent and more intense and travel farther in coniferous than broadleaf forests. Crown fires in the highly inflammable spruce forest are extremely hot, and the convection winds which they generate in the lower atmosphere often drive them forward at great speed. Surface fires may or may not accompany or be accompanied by crown fires. When following a period of drought, surface fires frequently consume all litter, the moss carpet and the peat layer down to the mineral soil. Sometimes, however, such fires will dip under wet moss carpets and travel in the dry peat layer, killing rooted plants but sparing the mosses. Hot fires are especially common around the dry, needle and cone-strewn bases of spruce trees.
>
> Few plants or slow-moving animals survive the holocaust which leads to a thoroughly burned spruce forest. But if the exposed mineral soil is a good one, then much of the nutrient materials released from bondage by fire in the form of ash will wash into the soil to produce a very favorable seed-bed. The area will then be rapidly invaded by a succession of fast-growing plant and animal populations. The result will be a mixed "fire-forest" dominated by seed trees of spruce, pine and birch, with occasional aspen and balsam poplar.
>
> Even if all of the organic matter in the original spruce forest was not removed by fire, the increased

illumination and amount of nutrients would encourage the growth of a multitude of plants and animals not found in the original spruce forest. Thus even a moderate fire produces a better rejuvenation than that following temporary breakup of an old spruce canopy with no fire. Barring further disturbance, however, the shade-intolerant pines and birches of the fire forest are slowly replaced by white spruce as the community reverts to the feather moss phase.

The volume of inflammable material is much less in the aspen forest, because decomposition rates usually keep up with accumulation rates, thus preventing the formation of thick litter and duff layers. Crown fires, too, are almost unheard of, for the leaves and branches of aspen are much less readily burned than are those of spruce. As a result, fires do not last long or travel fast in the aspen habitat, even after prolonged drought. Furthermore, after racing through a spruce forest, fires are frequently deflected or halted along the aspen forest margin.

. . .

Significantly enough, white spruce is *not* among those species which are able to regenerate vegetatively from surviving root systems. Thus at any time in the slow process of succession from aspen to spruce, the incidence of fire is disastrous for the spruce and a boon to the aspen.

In the mixedwood mosaic forest, fire may be intense in the pockets of pure spruce but light elsewhere. If so, then the aspen may expand at the expense of spruce, or the spruce may sucessfully re-establish itself in its old haunts by seed from unburned crowns or from nearby individual spruce trees which escaped the fire because of protection by aspen. We may therefore be pardoned for speculating that the mixedwood forest, the most common upland forest in Alberta's boreal taiga, is an evolutionary adaptation to fire, at the community level of biological organization.[7]

CHAPTER FIVE

HABITATS

Habitat Evaluation:

At least twelve different habitat types are found on Syncrude Lease 17, thus offering a rich variety of plant communities to wildlife (Figure 1).

Moose browse studies were made of these habitat types, with the exception of pure pine (Type 2), pure spruce (Type 3), and marsh (Type 11), which have obviously limited browse production.

Because of lack of time, the line transect study of herbs, forbs and grasses was not done. However, this only slightly limits this habitat analysis because these plants are not of importance in the diet of the important animals at the critical time of the year.

The lease area is discussed here in terms of these habitat types, with special emphasis on presently-utilized or potential habitat for wild ungulates--especially moose (*Alces alces*), but including mule deer *(Odocoileus hemionus)*, white-tailed deer *(Odocoileus virginianus)*, elk *(Cervus canadensis)*, woodland caribou *(Rangifer caribou)*, and barren ground caribou *(Rangifer tarandus)*.

No signs of mule deer were noted on the lease during this field work, although Soper (1964) states their range extends sporadically northward as far as Great Slave Lake. This has apparently occurred within the last 60 years. Men who have worked on the Syncrude lease over recent years described the occasional sightings of mule deer, especially in the autumn.

No caribou are presently found on the lease area. However, woodland caribou once ranged the forest in which the Syncrude lease occurs (Soper, 1964) but presently are restricted to pockets to the east and south of Fort McMurray and northwest of Lake Athabasca. Also, barren-ground caribou once extended their winter migrations as far south as Fort McMurray (Soper, 1964).

Elk also once ranged the area, and probably utilized the aspen groves and semi-open grasslands along the slopes of the Athabasca River.

Soper shows the range of white-tailed deer as extending up the Athabasca River as far north as Fort McMurray. However, they appear totally absent from the Syncrude lease.

In general, limitations of range for deer and elk in this area are probably snow depths and crust conditions, rather than lack of winter forage.

Habitat Study

A terrestrial wildlife habitat study was undertaken in the spring of 1972 as a follow-up to a moose survey of February, 1972, and an ecological impact evaluation of July, 1971 made. The objectives were:

1. To delineate habitat types on Syncrude Lease 17;

2. To assess their importance to wildlife including big game ungulates in the lease area;

3. To identify the critical habitat required by wildlife on the lease area.

Field work was conducted intermittently from April 27 - June 3, 1972. General observations were gathered for all wildlife species. An analysis of different habitat for browse plants was conducted using the Point-Center Quarter Method (Curtis and Cottam, 1959). Transects were run on a compass bearing at randomly-selected locations in representative

areas of each habitat type. Four samples were taken at each point on each line every two chains distance. There were a total of 40 point plots or 160 plants per type, except for willow muskeg. The degree of browsing on each shrub species was recorded, using an index system. Only shrub species which ranged from approximate snow accumulation level to the browsing height of a tall moose were included.

The following table (Table 3) indicates the twelve browse species measured, where present.

The relative density, relative dominance, relative frequency and importance value of each species in each habitat type were determined. Relative density is the number of individuals of one species as a percentage of the total number of individuals of all species.

Relative dominance is the total basal area of one species as a percentage of the total basal area of all species.

Relative frequency is the number of points of occurrences of one species as a percentage of the total number of points of occurrences of all species.

Importance value is the relative importance of each species in a community to each other and to the community as a whole, based on the relative density, relative dominance, and relative frequency. Each factor is of equal weight.

A habitat type map (Figure 1) based on vegetation cover of the Lease 17 area was prepared from aerial photos of September, 1967 (Scale: 1:31,680). Stereoscopic identification of habitat types was made from air photos and the area transposed to a base map with a scale of 1:50,000. Spot checks were made in the field to ascertain any significant changes which might have occurred since the original flight was made.

TABLE III

Common Name	Abbreviation*	Latin Name
Saskatoon berry	Amal	*Amelanchier alnifolia*
Willow	SAL	*Salix* spp.
Green alder	Alcr	*Alnus crispa*
Balsam poplar	Poba	*Populus balsamifera*
Aspen (poplar)	Potr	*Populus tremuloides*
Red osier dogwood	Cost	*Cornus stolonifera*
Paper (white) birch	BET	*Betula papyrifera*
Bog birch	BET	*Betula glandulosa*
Mooseberry (cranberry)	Vied	*Viburnum edule*
Honeysuckle	LON	*Lonicera* spp.
Chokecherry	Prvi	*Prunus virginiana*
Balsam fir	Abba	*Abies balsamea*

*Species names are coded using the first two letters of the Latin genus name plus the first two letters of the Latin species name, i.e., alder *(Alnus crispa)* = Alcr. When genus alone is used the first three letters of the Latin genus name appear in capitals, i.e. willow *(Salix* spp.) = SAL.

Twelve habitat types were delineated as follows:

Type 1	Pure aspen consocies
Type 2	Jackpine/lodgepole pine association
Type 3	Pure white spruce consociation
Type 4A	Boreal mixedwood: white spruce-aspen faciation
Type 4B	Boreal mixedwood: pine-aspen faciation
Type 5	Fen muskeg: sedge-willow-birch faciation
Type 6	Treed muskeg (black spruce) faciation
Type 7	Willow-muskeg consocies
Type 8	Recent burn (potentially productive)
Type 9	Old burn--aspen-dominated facies
Type 10	Riverine association
Type 11	Open marsh*

*Habitat types are discussed here as facies or faciations and associes or associations. A faciation is a climax community of one dominant species such as pure spruce; and a facies is a successional stage of a faciation, such as young spruce and mature aspen. An association is a climax plant community of more than one faciation, such as boreal mixedwood; and an associes is a successional stage of more than one facies. A consociation has a single climax dominant species; and a consocies is a successional stage of a consociation.

Key moose wintering range (Types 1, 4A and 10) was designated as well as key waterfowl areas.

Fifteen pellet group plots were set up in areas of intensive use to begin measurements of the trend of moose populations. Rectangular 1/50 acre plots (12' x 72.6') were used and permanently marked. These proved to be better adapted for the vegetation types than 1/100 acre circular plots. The number of pellet groups that have occurred in each plot since last autumn were counted. Pellet groups that were on the borderlines were included.

Type 1: Pure Aspen Consocies

Stands of larger pure aspen are found scattered on eastern portions of the lease but do not constitute a large area. The oldest stand is found on the northwest corner of Mildred Lake. Stands of small aspen are included under Type 9.

Shrub cover varies from site to site in the pure aspen stands. Species are listed in Table 1. Saskatoon-berry was most abundant on ridges and slopes such as those along-side Mildred Lake, whereas mooseberry and willow were most abundant on damper sites. Other plants noted in these pure aspen stands were buffalo-berry *(Shepherdia canadensis)*, conquefoil *(Potentilla sp.)* choke-cherry, rose *(Rosa spp.)* and red or other currants *(Ribes spp.)* as well as variety of grasses and forbs.

The browse survey showed that pure aspen stands are important moose wintering areas on the lease--ranking less in importance only to the spruce-aspen association of the mixedwood forest (Type 4A) and the riverine strip (Type 10), in terms of utilization by moose. Pellet plots also gave a similar index of importance. The pellet plots in pure aspen stands showed an average of 1.8 moose pellet groups per plot compared to 3.2 pellet groups per plot for the riverine habitat along the Athabasca River.

Especially important are the stands containing a good understory of saskatoon-berry, which is one of the most preferred browse species in the area. Twenty-six per cent of all the plants measured in pure aspen stands were browsed by moose, and most of these were saskatoon-berry. Thus, while willow and small aspen had a greater importance value than saskatoon-berry, they received far less utilization. Alder, while highest in importance value, was not utilized by moose. It was, however, heavily utilized by the varying hare *(Lepus americanus)*.

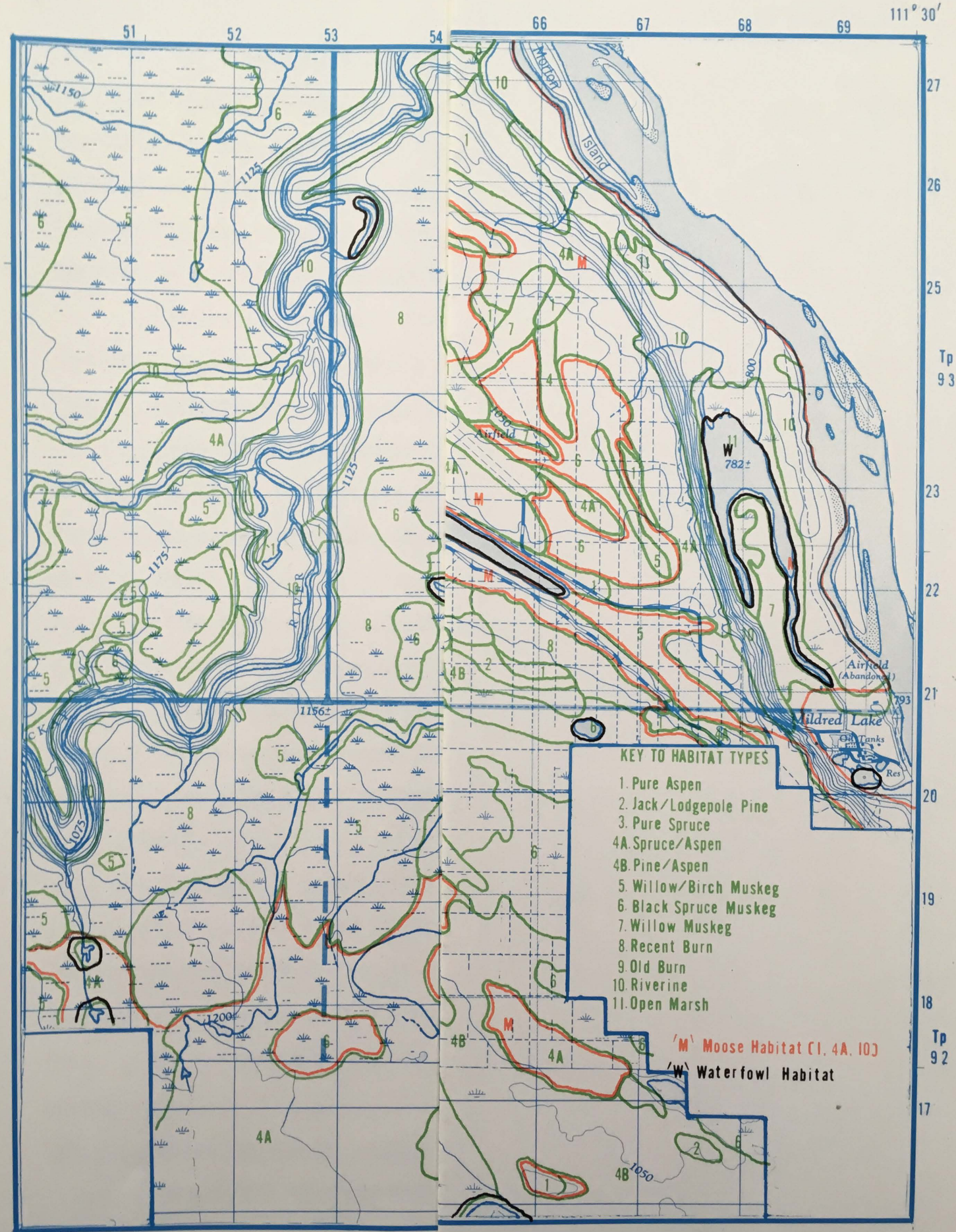

FIGURE 1–Map of Habitat Types

SCALE 1:50,000

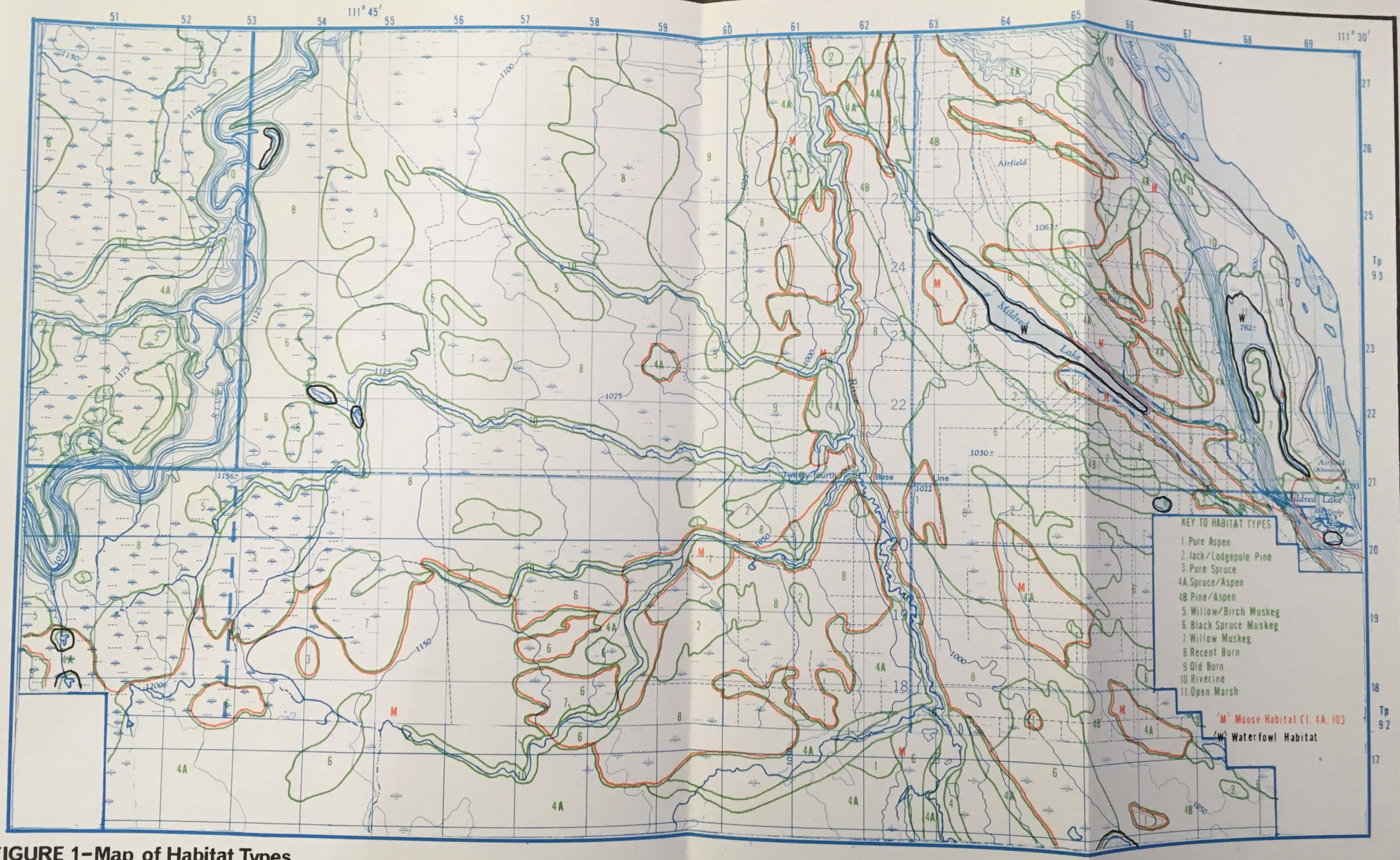

FIGURE 1–Map of Habitat Types

Pure aspen stands with "broken" edges are generally good habitat for ruffed grouse *(Bonasa umbellus)*, but only one bird was observed in this habitat during the course of the field work. Grouse appear to be at a low level of population. Varying hare, which utilized aspen stands in winter, also heavily browsed buffalo-berry, small aspen, and rose--although alder appeared to be their major winter feed.

The pure aspen stands in Lease 17 appear to have a poor potential carrying capacity for deer and elk because of heavy utilization by moose.

Type 2: Lodgepole Pine-Jackpine Association

This type is limited to dry sandy sites to the north and east of Mildred Lake and on southeastern portions of the lease (Figure 1). It is dominated by a varying mixture of lodgepole pine *(Pinus banksiana)* and jackpine *(Pinus contorta)*.

Pine forests have very little browse productivity and therefore have little or no value to moose.

Ground cover appeared to follow the two types designated by Moss (1955) where a pine-feather moss *(Hylocomium splendens* and *Calliergonella schreberi)* faciation exists on damper sites, and a pine-heath faciation on drier sites.[8]

Pine forests have limited value to other wildlife, except that lichens and moss, that offer potential feed for caribou. Black bear *(Ursus americanus)* were noted to feed in the early spring on kinnikinnick *(Arctostaphylos uva-ursi)* in a stand of pine on the east side of the Beaver Creek. Only two spruce grouse *(Canachites canadensis)* were noted in this habitat type.

Type 3: Pure White Spruce Consociation

Pure stands of white spruce *(Picea glauca)* are present only on the

bottomlands along the Athabasca River along the east side of, and to the north of, Horseshoe Lake. Since these stands have been altered by logging operations in recent years and are limited in size, they are included with the riverine habitat (Type 10). The largest noticeable effect of logging of these stands has been to allow a new growth of shrubs, dominated by red osier dogwood that is heavily utilized by wintering moose.

Type 4: Boreal Mixedwood Association

The Boreal mixedwood association on the lease is divided into two faciations: spruce-aspen (Type 4A) and pine-aspen (Type 4B), which cover an area far more extensive than the pure aspen and riverine types (the other two key moose wintering areas on the lease). Spruce-aspen covers a large area along the south boundary of the lease between Beaver Creek and the MacKay River, and large portions on the east side of the lease (Figure 1). Much of the riverine habitat is spruce-aspen in cover but is treated as a separate type, as will be explained under the riverine section.

Pine-aspen mixedwood stands are found extensively to the north of the Syncrude air strip and a few other areas, and are treated separately in the browse study.

In spruce-aspen, the composition varies in terms of the dominant tree species. An area sampled for browse, between Mildred Lake and the Syncrude air strip, is largely dominated by white spruce *(Picea glauca)*. The other area sampled, between the Fort MacKay Road and Morton Island on the Athabasca River, is largely aspen-dominated. Also, some pure stands of aspen with a good understory of predominantly saskatoon-berry, and some pure stands of white spruce, form small portions of the spruce-aspen mixedwood.

In the spruce-aspen faciation, saskatoon-berry has a much lower importance value than in the pure aspen type (Table 4). However, willow,

mooseberry, and red osier dogwood have higher importance values than in the pure aspen type. More willow and red osier dogwood plants were browsed in spruce-aspen than in pure aspen. Thus spruce-aspen is important moose winter range on the lease area. It also offers good potential winter range to deer and elk. Also, an abundance of grasses and forbs in parts of the spruce-aspen type offers good potential summer range to deer and elk. It also offers good habitat to ruffed grouse.

In contrast to spruce-aspen, the most important shrub in pine-aspen is alder, which is not preferred by moose (Table 4). Clumps of alder in pine-aspen, however, were severely hedged by rabbits. Saskatoon-berry had a higher importance value in pine-aspen than in spruce-aspen, but a lower percentage of plants were browsed by moose. Only 5% of all shrubs in the pine-aspen were browsed by moose. Most of the saskatoon-berry in pine-aspen were small, spindly plants which had been fairly well browsed by rabbits, and therefore largely unavailable to moose. This type is of little importance as moose winter range. However, good mats of kinnikinnick were noted in spots, providing abundant berries for black bear and spruce grouse.

Type 5: Fen Muskeg (Sedge-Willow-Birch) Faciation

This type forms fairly small areas on the lease. The low-lying area to the south of Mildred Lake, near the Fort MacKay road, was sampled as a representative area.

This type is dominated by a low mat of dense clumps of bog birch *(Betula glanulosa)* and willow with some clumps of marsh reedgrass and sphagnum moss and the occasional marsh marigold, Labrador tea *(Ledum groenlandicum)*, and other minor species. The occasional bog larch *(Larix laricina)* and black spruce is noted, and a margin of willow forms around the edges of this muskeg.

TABLE IV

SUMMARY OF DATA FOR EACH BROWSE SPECIES AND HABITAT TYPE

Species	Relative Density	Relative Dominance	Relative Frequency	Importance Value	No. of Plants Browsed	Percent Utilization
Map Type: 1 Habitat Type: Pure Aspen						
Amal	21.25	2.48	16.92	13.55	27	79%
SAL	15.00	16.93	21.54	17.82	6	25%
Alcr	19.38	51.00	18.45	29.61	-	-
Poba	2.50	2.81	3.08	2.80	-	-
Potr	21.89	12.53	21.54	18.65	1	3%
Cost	.63	.36	1.54	.84	1	100%
BET	1.25	5.08	3.08	3.14	-	-
Vied	18.13	7.80	13.85	13.26	6	21%
				Total:	41	26%
Map Type: 4 Habitat Type: Boreal Mixedwood Association						
A. Spruce-Aspen						
Amal	4.50	2.09	5.81	4.13	3	43%
SAL	17.00	31.16	19.77	22.64	10	37%
Alcr	5.85	32.25	8.14	15.41	-	-
Poba	2.50	1.53	4.65	2.89	-	-
Potr	9.70	10.78	11.63	10.70	1	7%
Cost	13.97	3.12	13.95	10.35	14	64%
BET	2.50	1.54	3.49	2.51	1	25%
Vied	43.98	17.53	32.56	31.36	7	10%
				Total:	36	23%
B. Pine-Aspen						
Amal	16.88	1.05	16.46	11.46	2	7%
SAL	6.25	2.72	7.59	5.52	1	10%
Alcr	38.12	77.75	32.91	49.59	2	3%
Poba	1.25	1.42	1.27	1.31	-	-
Potr	27.50	14.54	30.38	24.14	-	-
Vied	2.50	.30	2.53	2.29	3	75%
LON	1.25	.42	2.53	2.10	-	-
Prvi	6.25	1.80	6.33	7.84	-	-
				Total:	8	5%

TABLE IV (Cont.)

Species	Relative Density	Relative Dominance	Relative Frequency	Importance Value	No. of Plants Browsed	Percent Utilization
			Map Type: 5 Habitat Type: Fen Muskeg			
Amal	1.88	1.00	1.54	1.47	-	-
SAL	37.49	62.62	41.53	47.21	-	-
Poba	.63	.22	1.54	.80	-	-
Potr	2.50	1.53	1.54	1.86	-	-
BET	56.25	31.10	52.31	46.55	-	-
Vied	1.53	1.53	1.54	1.44	-	-
				Total:	0	0
			Map Type: 6 Habitat Type: Treed Muskeg			
SAL	49.38	71.26	48.21	56.28	19	24%
Potr	1.24	.48	3.58	1.77	-	-
BET	49.38	28.26	48.21	41.95	1	1%
				Total:	20	12.5%
			Map Type: 7 Habitat Type: Willow Muskeg			
SAL	63.75	52.03	58.06	57.95	12	24%
BET	36.25	47.97	41.94	42.05	-	-
				Total:	12	7.5%
			Map Type: 8 Habitat Type: Recent burn (potentially productive)			
SAL	36.25	50.72	41.42	42.80	-	-
Poba	27.50	12.44	30.00	23.31	-	-
Potr	30.00	29.15	21.43	26.86	-	-
Cost	2.50	2.78	1.43	2.24	-	-
BET	2.50	4.56	4.29	3.78	-	-
Vied	1.25	.35	1.43	1.01	-	-
				Total:	0	0

TABLE IV (Cont.)

Species	Relative Density	Relative Dominance	Relative Frequency	Importance Value	No. of Plants Browsed	Percent Utilization
		Map Type: 9 Habitat Type: Older burn (Aspen-dominated)				
Amal	1.25	.04	1.15	.81	1	100%
SAL	28.75	57.88	29.88	38.84	5	11%
Alcr	6.25	11.52	8.05	8.64	2	20%
Poba	18.75	6.87	17.24	14.29	1	3%
Potr	33.13	19.13	27.58	26.61	-	-
Cost	7.50	3.37	8.05	6.31	4	33%
Vied	5.00	1.19	8.05	4.75	4	50%
				Total:	17	11%
		Map Type: 10 Habitat Type: Riverine				
Amal	2.50	.22	2.47	1.73	1	25%
SAL	1.88	7.92	2.47	4.09	2	67%
Alcr	10.63	27.73	9.88	16.08	-	-
Poba	10.63	5.51	13.59	9.91	7	4%
Potr	.63	.16	1.23	.67	1	100%
Cost	43.47	35.53	35.80	38.36	51	73%
BET	3.75	8.14	6.17	6.02	1	17%
Vied	18.74	3.88	19.75	14.12	4	13%
Abba	5.62	9.73	4.94	6.77	-	-
LON	1.25	.30	2.47	1.34	-	-
Prvi	.63	.88	1.23	.91	-	-
				Total:	67	42%

In western portions of the lease these areas were primarily sphagnum-labrador tea associations, but were not sampled.

Table 4 shows that bog birch and willow have very high importance values in this association, whereas saskatoon-berry, aspen, balsam poplar and mooseberry have low values. None of the plants samples were browsed by moose. Indeed, most birch and willow shrub are unavailable to moose because of severe winter hedging by rabbits, which left most plants with dead woody stems and only small leaf buds near the ground. Thus, only the narrow margin of higher willow around the edge of these muskegs is presently available to moose. This type of muskeg seems to be most important habitat for rabbits and their associated predators.

Some ptarmigan may utilize this edge of willow in the winter, feeding on the buds.

The few sandhill cranes *(Grus canadensis)* which nest near the test pit area probably nest in this type of habitat, although the actual nesting area was not determined.

Type 6: Treed Muskeg (Black Spruce) Faciation

Treed muskeg forms extensive areas on southeastern portions of the lease. Two areas were sampled: one between the Fort MacKay road and Morton Island, and the other about one mile west of the present Syncrude pilot plant and camp.

Cover varies from thick stands of black spruce to semi-open areas with black spruce, bog larch, scattered clumps of willow, bog birch, and a few small aspen and balsam poplar.

Willow and bog birch are the most important browse species of this type. Twelve and one-half per cent of all species were browsed, mostly willow. Thus this type has some secondary value as moose winter range.

As in Type 5, there was severe browsing by rabbits on small spruce, larch, aspen, and bog birch. In some instances, small evergreens were chewed down to stubs of one-inch diameter, or the bark had been "ringed." This type may provide winter habitat for spruce grouse and, possibly, ptarmigan (one spruce grouse was noted in the type).

Type 7: Willow-Muskeg Consocies

Type 7 is very limited in area on the eastern, and more accessible, portions of the lease, but forms fairly extensive areas on recently-burned areas of muskeg towards the MacKay River. It is also found along the flats of the Beaver Creek and small tributaries, extensively around the edges of the marsh near the Syncrude air strip, and on the edges of Horseshoe Lake (Figure 1).

Only eighty plants were sampled from this type, on an area near the end of the road that runs up the west side of the Beaver Creek from the Fort MacKay road. This area was a burned-over black spruce muskeg, which had been revegetated with healthy clumps of willow five to fifteen feet high--with a lower shrub cover dominated by bog birch and willow. The dominant ground cover was marsh reed-grass and sedge, with some marsh marigold and other forbs present.

Both willow and bog birch had high importance values. As usual, the bog birch was heavily hedged by rabbits, and thus unavailable to moose. Seven and one-half per cent of all the plants were browsed by moose, and all of these were willow--indicating that willow muskegs have some secondary value as moose wintering habitat.

In general, moose appeared to prefer saskatoon-berry shrubs in aspen groves to patches of willow where both were available. For example, only a few clumps of willow were noted to be browsed around the marsh at the Syncrude air strip but saskatoon bushes in a stand of pure aspen on the edge of the

marsh were heavily utilized. Several moose were noted to browse on clumps of willow along the edge of Horseshoe Lake from late April to mid-May. However, an examination of the area showed far heavier browsing on other species adjacent to the willow edge (see riverine type) than on the willows themselves.

Lorraine Allison (Personal communication, 1972) noted that moose on the Peace-Athabasca Delta make heavy summer use of willow leaves. While this was not observed on the Syncrude lease, it undoubtedly occurs.

Slight hedging of willow buds by ptarmigan was noted, and the willow muskegs may serve as wintering areas for these birds.

Willow muskegs are of little value to other wildlife.

Type 8: Recent Burn (Potentially Productive)

Recent burns, or areas classified by the Alberta Forest Service as "potentially productive", are found extensively to the southwest of Mildred Lake and on both sides of the Beaver Creek where the test pit area is located. Both of these locations were sampled in the browse study.

These areas appeared to have been burned within the last ten years, and have been invaded by a wide variety of trees and shrubs which varied in density from site to site. Thus, there are white spruce, black spruce, pine, aspen, balsam-poplar, a few bog larch, and an interspersion of many shrub species. Willow has by far the highest importance value, with aspen and balsam-poplar ranking next in order. Red osier dogwood, birch, and moose-berry are relatively unimportant.

Other shrubs noted were rose, currant, labrador tea, honey-suckle, buffalo-berry, and cinquefoil (abundant in places). The latter two shrubs were heavily browsed by rabbits. Other plants noted were kinnikinnick, huckleberry, and a variety of forbs including wild strawberry.

No plants in the line transects were browsed by moose--an indication

that these areas have little utilization by wintering moose, although they have good shrub forage available except for Saskatoon berry. Lack of sufficient cover may limit use of these areas by wintering moose.

Rabbits browsed heavily on pine. In one site a whole stand of small pine had been killed by rabbits' over-browsing, while small spruce were emerging untouched.

Some signs of black bear were noted, especially where they root for ants in old stumps and fallen trees. A few woodchuks *(Marmota monax)* were noted near the test pit area, but are probably not restricted to this habitat type alone.

Type 9: Older burn Aspen-Dominated Facies

An older burn, dominated by aspen ten to thirty feet high, forms one of the most extensive areas on the lease--occupying a good portion of the western half. These areas are found extending from the Beaver Creek about one-half mile west of the test pit area to west of the MacKay River.

According to the Fire Protection Officer in Fort McMurray, this burn probably occurred in the late 1940's.

The area sampled for browse species was along the road that runs up the west side of Beaver Creek from the Fort MacKay road.

As with Type 8, willow was the most important shrub species, with an importance value of 38.84. Aspen, which was within reach of moose, was the second-most important, followed by balsam poplar. Following, in order of decreasing importance value, were alder, red osier dogwood, mooseberry and saskatoon berry.

Eleven per cent of all the shrubs sampled were browsed, indicating that this area is of secondary value to wintering moose. Good cover probably accounts for use of this type by moose, compared to more recent burns where

there is little cover.

The extensive aspen-covered burn on the western portion of the lease certainly offers the most potentially-productive moose winter range on the lease, once the stands become more mature.

Rabbits appeared to make heavy use of these areas.

Type 10: Riverine Association

This type comprises areas of forest cover which are unique because of their proximity to rivers or creeks (i.e. river edges, flats, and valley slopes).

On the lease area, the riverine type included:

1. The flats and slopes adjacent to the Athabasca River (riverbreak zone);
2. The bottom flats and adjacent slopes of Beaver Creek;
3. Most of the small tributaries of Beaver Creek; and
4. The valley of the MacKay River.

The most productive riverine area is located between Horseshoe Lake and the Athabasca River, including the slopes to the west of Horseshoe Lake. These areas are mainly logged-over white spruce-aspen stands, with small stands of large balsam-poplar adjacent to the Athabasca River. The lower elevation and greater fertility of the soil in parts of the riverine zone is conducive to a richer growth of plant life. For example, red osier dogwood reaches almost tree size along the Athabasca River whereas, in areas of high elevation, it was typically a low shrub.

The area between Horseshoe Lake and the Athabasca River was sampled during the browse study. Red osier dogwood had an importance value of 38.36 and was 73% browsed--the highest combined index of importance value and browse utilization of any shrub species sampled on any other habitat type.

Alder has an importance value of 14.12 and was 17% browsed. Other shrubs of lower importance that were browsed were saskatoon berry, willow, balsam poplar, aspen and white birch. Balsam fir *(Abies balsamea)* was found on drier sites, but was not utilized. Honeysuckle and chokecherry were of low importance and were not utilized.

Thus, the riverine area along the Athabasca River constitutes the most important moose winter range on the lease, in terms of availability and utilization of browse. This is also reflected in the trend-index data, where pellet plots for this type gave a higher average than in the pure aspen type.

The banks and flats along Beaver Creek also appeared to be fairly important moose winter range because of a good availability of browse, and the natural shelter which the river depression offers from prevailing winter winds. Flats examined upstream from Beaver Creek campgrounds showed a good availability of willow, aspen, balsam poplar, mooseberry, white birch and some saskatoon berry. Some had been well-utilized by wintering moose. Several sites examined farther upstream, towards the Syncrude test pit, showed heavy utilization of saskatoon berry in aspen slopes adjoining the river.

Farther upstream the small tributaries of Beaver Creek have good "edges", or flats, of willow. A brief examination of these determined that they were only lightly used by wintering moose.

The riverine type is good ruffed grouse habitat--especially the areas near Horseshoe Lake, where most ruffed grouse were noted. It is also good black bear habitat.

Type 11: Marsh

Only a few small sedge marshes--with the exception of the ones around Horseshoe Lake--are found on the lease area, and are relatively unimportant as wildlife habitat.

Mildred Lake:

Mildred Lake is the largest lake on the lease--covering approximately 340 acres. It drains northwesterly from its north end into Beaver Creek. The lake appears shallowest towards the north end.

The lake was ice-free by May 8, and the following vegetative analysis was made near the end of May.

Most of Mildred Lake is forested to near the edge with a treed margin of willow, alder, and bog birch, and a narrow ground fringe of marsh reedgrass *(Calamagrostis canadensis)*, sedge *(Carex* spp.*)* with minor plants such as marsh marigolds *(Caltha palustris)* and horsetail *(Equisetum* spp.*)*.

In some areas, dead willows line the shore, or the lake is forested right to the water's edge.

Most of the shoreline has a narrow zone of emergent vegetation ten to thirty feet wide, dominated by cattail *(Typha latifolia)* with some sedges *(Carex atherodes)*, common spikerush *(Eleocharis palustris)* and pickerel weed *(Pontederia* sp.*)*. There are some floating hummocks of march reedgrass. The north and south ends both have "floating" edges.

Submergent vegetation was briefly examined. The south end, near to shore, has a loose, rich organic bottom with a submerged matt of moss *(Hypnum* spp.), mare's tail *(Hippuris* sp.*)*, hornworts *(Ceratophyllum* sp.*)*, and some green algae growth.

An area on the east side of Mildred Lake, near the middle where the bottom drops off steeply from shore with no margin of cattail, has a three- to four-inch layer of organic mud with submerged bottom plants of water-weed *(Elodea canadensis)*, hornworts and moss.

Duckweed *(Lemna minor)*, a good duck food, and a "pond scum" of filamentous algae *(Spirogyra* sp.*)* floated along the edge. A few pond lilies

(Nymphaea sp.*)* were noted.

Towards the end of May, the northern half of the lake became cloudy with a light creamy-brown appearance, suggesting a "bloom" had taken place.

A rich variety of invertebrate life was present, including leeches and snails *(Lymnaea* sp., *Planorbis* sp., and *Trivolvis* spp.*)*.

The variety of insect and plant life on Mildred Lake provides good feed for the numbers of waterfowl that use the area during spring migration. The presence of up to 400 lesser scaup *(Aythya affinis)* on the lake, for a continued period during part of May, suggests that an abundance of submerged vegetation is available at that time. An abundance of snails and other invertebrates provides good feed for common goldeneyes *(Bucephala clangula)* and buffleheads *(Bucephola albeola)*, which were common on the lake during the spring.

The narrow margin of shore vegetation limits the value of Mildred Lake as nesting habitat to such ground-nesting species as lesser scaup and widgeon *(Mareca arnericana)*. Two or three pairs of common loons *(Gavia immer)* and some red-necked grebes *(Podiceps grisegena)* also appeared to be nesting along the lake. Some bufflehead and common goldeneye appear to nest in holes in dead aspen *(Populus tremuloides)* snags near the shoreline.

A few beaver *(Castor canadensis)* were noted on Mildred Lake but no muskrat *(Ondatra zilbethicus)* were observed. Water shrew *(Sorex palustris)* live along the edge.

Moose *(Alces alces)* probably feed upon aquatic vegetation along Mildred Lake during the late summer, to escape the flies.

Horseshoe Lake:

Horseshoe Lake is located along the bottom of the Athabasca Valley,

and is much shallower than Mildred Lake. It is slightly smaller (about 320 acres but has a much wider shore margin of sedges, grasses, and willow.

The water regime of Horseshoe Lake has been altered by a canal at the north end which drains into the Athabasca River. The canal was built in about 1955 by the oil company then holding the lease. During spring "break-up", water and ice from the Athabasca River flow into Horseshoe Lake via the canal. In mid-May, as the river level recedes, Horseshoe Lake drains out through the canal, and water levels drop sharply. By late summer the lake reaches low levels, and may dry up in very dry years. The fluctuation creates desirable habitat for dabbling ducks such as the mallard.

Horseshoe Lake has a richer growth of aquatic vegetation than any other lake in the area. Growth begins earlier because of the early spring flooding of the lake by water from the Athabasca River, which has been heated by thermal emissions from the Great Canadian Oil Sands Plant.

The bottom of Horseshoe Lake is covered with a mat of moss, hornwort, and other submerged plants. By mid-May the open water is choked with water-lily, duckweeds *(Lemna minor, L. trisulca)* and filamentous algae which form a dense mat on the surface, along the edges.

Marginal vegetation is dominated by cattail, with some hardstem bulrush *(Scirpus validus)* and common spikerush.

Sedge and marsh reedgrass form a wide margin along most of the lake, and a large meadow at the north end.

This lake receives its heaviest use by waterfowl during the first two weeks of spring migration.

In the spring several moose were seen feeding daily along the edge on willows, but they disappeared about mid-May. The moose probably utilize this lake later on in the summer, as pond lilies are good summer moose feed.

A few beaver and their lodges were noted on Horseshoe Lake, but no muskrat were observed. According to local residents, muskrat were once abundant on Horseshoe Lake, before it was drained.

Riverine Habitats:

Beaver Creek, and a number of small tributaries to the west of Syncrude's present test pit area, offer limited habitat to wildlife. The relative abundance of beaver has been discussed in other parts of this discussion.

Some waterfowl utilize beaver dams on Beaver Creek, and its tributaries, during spring migration, but this use is limited.

A ground check of some beaver dams to the west of the present test pit on May 31 showed a good growth of duckweed *(L. minor)* and filamentous algae on the surface, but no ducks were noted.

Some common mergansers *(Mergus merganser)*, which are fish-eaters, were noted on Beaver Creek.

The MacKay River, being larger and faster-flowing than Beaver Creek, has little to offer wildlife. Small numbers of migrant ducks were noted along its edges and side channels, immediately after spring break-up.

FOOTNOTES

[1]George H. La Roi, M.Sc., Ph.D., "Taiga" in "The Boreal Forest," Alberta: A Natural History (Edmonton: Canadian Utilities Limited, 1967), pp. 158 - 160.

[2]Ibid., pp. 160 - 161.

[3]Ibid., pp. 161 - 164.

[4]Ibid., p. 165.

[5]Cyril G. Hampson, B.A., Ph.D., "Summer Animals" in "The Boreal Forest," Alberta: A Natural History (Edmonton: Canadian Utilities Limited, 1967), pp. 169 - 170.

[6]William A. Fuller, M.Sc., Ph.D., "Winter in the Northern Forest" in "The Boreal Forest," Alberta: A Natural History (Edmonton: Canadian Utilities Limited, 1967), pp. 172 - 184.

[7]La Roi, Op. Cit., pp. 166 - 169.

[8]E. H. Moss, "The Vegetation of Alberta," The Botanical Review Vol. 21, No. 9, 1955.

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